**Quantification of Biological Processes**

ABE 4662 Section 8095

***Class Periods:*** MWF period 3

***Location:*** McCarty B MCB 3124 with goal to move to Frazer Rogers Computer Lab 282

***Academic Term:* Fall 2025**

***Instructor:***

Melanie Correll, Ph.D.

correllm@ufl.edu

352-294-6722

Office Hours: Tues 9 -10:30 am with arrangements, or best by appointment correllm@ufl.edu. Zoom meetings can be arranged.

***Course Description***

Quantitative description and analysis of biological processes pertaining to microbes, plants, animals, and ecosystems. biological transport phenomena, bioenergetics, enzyme kinetics, metabolism, bioregulation, circulatory and muscle systems, and agroecosystems. Analytical and experimental laboratory for development of quantitative skills. (Offered Fall) (3 credit hours)

***Course Pre-Requisites / Co-Requisites***

ABE2062 or BSC2010/2011, EML3100, EGN3353 OR CWR3201, ABE3612C or EML4140

***Course Objectives***

After taking this course students will be able to:

• Gain fundamental knowledge to understand quantitative descriptions and the analyses of biological processes. (Homework, Projects, Exams)

• Demonstrate proficiency in the use of computational tools to analyze and model biological processes.

• Identify, formulate, and solve problems related to biological processes. (Homework, Projects, Exams)

• Develop teamwork and presentation skills to report and solve problems related to biological processes. (Projects- group)

***Materials and Supply Fees***

None, materials will be available at open-source locations or provided on Canvas.

***Relation to Program Outcomes (ABET):***

*This course contributes 3 credit hours toward meeting the minimum 48 credit hours of Engineering Topics in the basic-level curriculum for the Bachelor of Science Degree in Biological Engineering.*

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| **Outcome** | **Coverage\*** |
| 1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
 | Medium |
| 1. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
 | Low |
| 1. An ability to communicate effectively with a range of audiences
 | High |
| 1. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
 | Low |
| 1. An ability to function effectively on a team whose members together provide leadership, create a collaborative environment, establish goals, plan tasks, and meet objectives
 | High |
| 1. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
 | Medium |
| 1. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies
 | Low |

***Required Textbooks and Software - none required***

***Course notes and reading assignments are opensource or are provided by the instructor.***

***Recommended Materials***

*Author: Angela B. Shiftlet and George W. Shiftlet*

*Publication Date and edition: Princeton University Press, Copyright 2014*

*Hardcover 2014 ISBN 9780691160719 OR*

*E-book ISBN 9781400850556*

*E-book ISBN 9781400851485*

***Software:  Vensim® , Python/Jupyter Notebooks, and R Programming (all are opensource) and/or MATLAB (UF APPS). Details of downloading and use of these will be provided in CANVAS.***

***Required Computer***

Recommended Computer Specifications: <https://it.ufl.edu/get-help/student-computer-recommendations/>

***HWCOE Computer Requirements****:* [*https://www.eng.ufl.edu/students/advising/fall-semester-checklist/computer-requirements/*](https://www.eng.ufl.edu/students/advising/fall-semester-checklist/computer-requirements/)

***Other Recommended Resources:***

* *Biological Process Engineering and other assigned reading material that will be provided by the instructor. Author:Arthur T. Johnson, Publication date and edition: John Wiley and Sons, Inc Copyright 1999 ISBN Number: 0-471-24547-X*

* *Mathematical Models in Biology (An Introduction). Author:  Elizabeth S. Allman and John Rhodes,  Publication date and edition: Cambridge University Press, Copyright 2004 ISBN Number: 0-521-52586-1*

* *Computer simulation in biology (A basic introduction). Author:  Robert E. Keen and James D. Spain.  Publication date and edition: Wiley-LISS, Copywrite 1992 ISBN Number:  0-471-50971-X (out of press, used versions can be had and will be provided by the instructor)*

***Course Schedule***

***Course Schedule (topics vary by semester and student interest), this is a tentative schedule as these can be adjusted due to a variety of unforeseen issues and unexpected conflicts.***

Unit 1 (week 1): Introduction to Computational Tools to Analyze Data and Model Biological Processes- use of AI tools (ChatGPT, Gemini to code in Python etc.)

Unit 2 (week 2-3): Constrained and Unconstrained Growth in Biological Systems (Homework (HW), HW1) – coding with AI, image creation with AI – variability in AI outputs based on “training”, AI Navigator.

Unit 3 (week 3-4): Compartmental Models (Pharmacokinetics, drug delivery, susceptible, immune, recovered (SIR) models) (HW2)

Unit 4 (week 5): Numerical Methods and Errors in Modeling Processes (HW3)

Unit 5 (week 5-6): Enzyme Kinetics (HW4)

Unit 6 (week 6-7): Empirical Modeling and Data Analytics for Biological Systems using AI

 **Project #1 - Presentations and Report**

Unit 7 (week 8): Stochastic Models and Diffusion (HW5)

Unit 8 (week 9): Cellular Automata of Biological Systems Part I (HW6)

                  **Mid Term Exam #1 up to Unit 6 material**

Unit 9 (week 10-11): Cellular Automata Part II (HW7)

Unit 10 (week 11): Machine Learning for Image/Data Classification of Biological Systems)

Unit 11 (week 12-13): AI use for Biological Systems Studies

                   **Project #2 Presentations and Report**

Unit 12 (weeks 14): Project #3 Development (HW 8)

Final Presentations (week 14/15)

                  **Project #3 Presentations and Report**

            **EXAM 2:   Final Exam – components of the semester but focused on the Units from (Unit 6 or 7)- until the last Unit of the Semester (exam will be due on the University Scheduled time for exams for this course).**

**Exam:**
Thursday 12/10/2025 @ 10:00 AM - 12:00 PM The exam will be due by the end of the exam slot.

Time of Class Exams: MWF 3, 9:35 - 10:25 am.

***Attendance Policy, Class Expectations, and Make-Up Policy***

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies shown under the Academic Policy & Resources.

***Academic Policies & Resources***

<https://go.ufl.edu/syllabuspolicies>.

* Attending and participating in class is required (some material is only provided in class)  Absences will be excused that are consistent with the university policies noted at <https://go.ufl.edu/syllabuspolicies> , if you know of a planned absence please notify the instructor at the earliest date.
* **Using notes, projects, reports, and/or codes from previous offerings of this course or from answer books for textbooks is considered cheating.**
* **Giving code or other materials provided in class to other students that missed class is considered cheating (unless approved directly by the instructor)**
* Assisting other students on troubleshooting their code, **this is cheating on exams** or if indicated by instructor, but is helpful and Not Cheating on homework and projects (limit the amount of code you provide so other students can learn how to troubleshoot).
* Letting the instructor know of a**known**missed absence ahead of time is expected.
* Getting materials from the instructor for excused absences is expected.
* Using professional attitudes and meeting deadlines is expected.
* Making an appointment (or using the office hours) for out-of-class assistance with instructor prior to the day that an assignment is due is expected.
* Putting your best effort in this course is expected.
* Completing the To Do Lists/Assessments in the Units with your BEST EFFORT is Expected
* Using supplemental material to cover areas you need to get to the level required by the unit is expected.
* Late assignments (for projects and homework,**no late exams are accepted**except in university excused absences) start with 10% deduction at 5 minutes after the due date/time and then this 10% deduction continues until 9:35am for the next class meeting (usually a Monday). Then at 9:36am on the next class date (usually a Monday) 20% deducted until 9:35am on the next class date (usually a Wednesday) after 9:36am on this second class date (usually a Wednesday) until the end of the third class day (usually a Friday) by end of this work day (5pm) 30% will be deducted. No late homework beyond the third missed class (usually Friday) will be accepted unless following University guidelines with instructor.

***Use of AI***

This courses uses AI for coding and troubleshooting including for documentation or for developing images/tables and figures. Therefore, the use of AI will be allowed except in a few cases outlined by the instructor. Please cite the AI tool and either the key prompts or the way in which the AI tool was used, details on how to do this will be provided and given in class and will depend on the type of assignment (e.g., project, exam, or homework).

***Commitment to a Positive Learning Environment***

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University’s core values.

If you feel like your performance in class is being impacted, please contact your instructor or any of the following:

• Your academic advisor or Undergraduate Coordinator

• HWCOE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu

• Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu

***Evaluation of Grades***

|  |  |  |
| --- | --- | --- |
| ***Assignment*** | ***Points*** | ***Percentage of Final Grade*** |
| ***Homework Sets (approx. 8)*** | ***10 each***  | ***40%*** |
| ***Projects (3)*** | ***100 each***  | ***30%*** |
| ***Midterm Exam*** | ***100*** | ***15%*** |
| ***Final Exam*** | ***100*** | ***15%*** |
| ***Total:*** |  | ***100%*** |
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***Grading Policy***

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| --- | --- | --- |
| ***Percent***  | ***Grade***  | ***Grade Points***  |
| ***93.5 - 100*** | ***A*** | ***4.00*** |
| ***89.5 - 93.4*** | ***A-*** | ***3.67*** |
| ***86.5 - 89.4*** | ***B+*** | ***3.33*** |
| ***83.5 - 86.4*** | ***B*** | ***3.00*** |
| ***79.5 - 83.4*** | ***B-*** | ***2.67*** |
| ***76.5 - 79.4*** | ***C+*** | ***2.33*** |
| ***73.5 - 76.4*** | ***C*** | ***2.00*** |
| ***69.5- 73.4*** | ***C-*** | ***1.67*** |
| ***66.5 - 69.4*** | ***D+*** | ***1.33*** |
| ***63.5 - 66.4*** | ***D*** | ***1.00*** |
| ***59.5 - 63.4*** | ***D-*** | ***0.67*** |
| ***0 - 59.9*** | ***E*** | ***0.00*** |

***Academic Policies & Resources***

To support consistent and accessible communication of university-wide student resources, instructors must include this link to academic policies and campus resources: <https://go.ufl.edu/syllabuspolicies>. Instructor-specific guidelines for courses must accommodate these policies.

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